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The Effects of Electronic Data Processing in Future Instructional Systems

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SYSTEM DEVELOPMENT CORPORATION, SANTA MONICA, CALIFORNIA

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At the recent Workshop on Educational Data Processing held at the System Development Corporation in Santa Monica, California,** it was revealed that increasing numbers of school districts and higher learning institutions are installing electronic data-processing systems (EDP systems) for the management of educational data. This development, coupled with the already extensive use of electronic accounting machines in the pupil-personnel, registrar, and business offices, seems to portend even further automation in our schools and universities. There was good evidence, too, that this automation will gradually extend into the classroom itself. For if the developments of automatic translating machines, computer-based teaching devices, rapid document-retrieval systems, computerized models of school system operations, and other similar applications of computer technology come to fruition, the digital computer and its peripheral equipment will support most of the subsystems in the total school system complex.

The research and technological developments discussed at the Workshop can be summarized as follows:

1. The computer-based teaching machine. By branching students laterally, backward, and forward through subject material, the machine develops a course of study particularly suited to the individual student's educational background, level of motivation, and aptitude.

2. Information retrieval systems. Up-to-date information in any area of the arts and sciences can be provided by information centers utilizing abstracting and translating machines; techniques of rapid retrieval and

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dissemination of data; and data-link transmission lines that link the school satellite computer with information centers.

3. Simulation programs. Computer-based programs of simulation will aid ongoing management and instructional activities by:
   a. Supplying periodic economic or population forecasts.
   b. Helping to balance budgets.
   c. Giving guidance in the planning of new educational facilities.
   d. Expediting the training and selection of educators.
   e. Facilitating classroom and vocational instruction.

4. The automated classroom. There is new technology for processing educational data and for organizing instructional material in the classroom. Counselor and teacher data displays, automated diagnostic routines, preprogrammed TV lessons, and programs permitting student-directed exploration of subject matter will result from such techniques.

The Workshop participants further concluded that in an educational system, one integrated data center might serve the needs of the administrator, teacher, counselor, curriculum developer, and student. The example used was that of students carrying on independent study with programmed materials and leaving a detailed record of their learning experience by making multiple-choice answers to questions on material displayed in teaching machines. These records would be stored in a central computer on magnetic tape. The information thus stored is of interest to the counselor, for it reveals each student's individual learning problems. The curriculum developer has summary data covering many students' learning experiences for specific curriculum evaluation and modification. Teachers have an up-to-the-minute account of each student's level of understanding of the subject matter and the extent of his progress. The school librarian can update the student's information-need profile and guide the teacher in selecting special materials intended to resolve some of the student's learning needs. Rate of progress of the individual learner is of interest to the administrator who may need to monitor and schedule individual study programs in the individualized, non-graded school system environment of tomorrow.

This example of the total systems concept in the storing and retrieving of educational data and information serves to make the point. Even though present applications of EDP systems in education are limited in scope, if the results of current research are applied to the future configuration of school systems, and if centralized data processing continues to expand, educators are in for a major technological change in their profession.

There is the question of other developments in computer technology which should be initiated for the realization of long-desired educational goals. None of these developments, to be discussed below, were touched upon at the EDP Workshop, nor are they likely to be for many Workshops to come, as it will be

obvious in the reading that there are many breakthroughs to be made before they are applied in educational practice. However, the futuristic look at new developments raises an interesting question of the readiness of the educator to utilize the technology when it does exist.

Effortless Learning, Attitude Changing, and Training in Decision Making.

In 1960, Dr. S. Seshu, Professor of Electrical Engineering at Syracuse University, conceived of the penultimate teaching machine as an electronic transducer or input system which transfers factual information stored on punched cards or magnetic tape directly into human memory.* This would be accomplished without preliminary processing of the information by the visual or aural senses. "All that we need to do," suggests Seshu, "is to find the input terminals in the human brain and the necessary code--the gadgetry is trivial." His contention is that the basic trouble with the teaching machine or any modern learning method, is that the input is fed in at the wrong place. When the input to the brain arrives visually or aurally, it is often distorted or lost in the transference process. What is needed is a transducer capable of transferring information to the human memory with the same ease and accuracy of data being transferred into the memory of an IBM 7090. Recognizing the major barriers yet to be surmounted by the physiological psychologist, it is conceivable that such a machine may eventually exist. The question arises: should the effortless learning machine teach beyond the limits of factual data? If the student can assimilate information without error, shouldn't the teacher also steep him in the culture, train him in the proper professional attitudes, and thoroughly ground him in the scientific method as a way of life? It is difficult to know where the responsible instructor would leave off in the use of this effective tool.

Another area of potential development in computer applications is the attitude-changing machine. Dr. Bertram Raven, in the Psychology Department at the University of California at Los Angeles, is in the process of building a computer-based device for changing attitudes.** This device will work on the principle that students' attitudes can be changed effectively by using the Socratic method of asking an appropriate series of leading questions logically designed to right the balance between appropriate attitudes and those deemed less acceptable. For instance, after first determining a student's constellation of attitudes through appropriate testing procedures, the machine would calculate which attitudes are out of phase and which of these are amenable to change. If the student was opposed to foreign trade, for example, and a favorable disposition were sought, the machine would select an appropriate series of statements and questions organized to right the imbalance in the student's attitudes.

*Seshu, S. The penultimate teaching machine. IRE Transactions on Education. Vol. E-3, September, 1960. pgs. 100-101.

**Personal Correspondence.

The machine, for instance, would have detected that the student liked President Kennedy and was against the spread of communism; therefore, the student would be shown that JFK favored foreign trade and that foreign trade to underdeveloped countries helped to arrest the communist infiltration of these governments. If the student's attitudes toward Kennedy and against communism were sufficiently strong, Dr. Raven would hypothesize that a positive change in attitude toward foreign trade would be effectively brought about by showing the student the inconsistency of his views. There is considerable evidence that such techniques do effectively change attitudes. The question arises: what is the appropriate subject material, or "attitudes," in this instance, with which to indoctrinate the student?

One further example: At the Catholic University of America in Washington, D. C.,* a psychological research program is underway to study the problems of training a student in decision-making skills. A special-purpose computer and display equipment will present the student with a series of numerical problems designed to test the student's ability to make good decisions at maximum speed.

Admittedly, training in decision-making skills is a legitimate goal of education in this age of automation, but the problem remains--does the educator know what values to attach to the different outcomes of these decisions? What about the students whose values are out of line with the acceptable values of democratic society? Should they be taught to conform to someone else's accepted judgment of proper values? Training in decision making is ultimately compounded with training in value judgment and, as such, becomes a controversial subject that needs to be resolved by educators before the tools can be put to use. Progress must be made not only in data-processing technology, but in our knowledge of educational requirements. Automation requires a clear, operational statement of objectives to be accomplished by the system being automated. The desired student behaviors and attitudes must be more precisely defined, and research must be directed toward discovering optimal combinations of instructional techniques to produce these behaviors.

Trends in Hardware Development and Related Costs.

The tools represented in all of the development described are admittedly expensive. If the question were asked whether or not education could afford the medium- or large-capacity computer, the answer today would have to be "No." But multi-processing, miniaturized, large-capacity computers are on the horizon, and it is felt that the tools will become economically feasible in the next two or three years even for the small school districts.

*Personal Correspondence

If computer-based instructional systems are to be applied on any vast scale, they must be economically competitive with other systems performing similar functions. Some increase in equipment costs can be justified by improved teaching efficiency and a subsequent reduction in training time and operational waste. It seems clear that computer-based systems must approach the over-all cost of more conventional equipment if they are to be used for more than specialized military or industrial training applications. This development seems to be the trend, however, in miniaturized, large-capacity systems.

There appear to be other avenues by which the cost of computer-based instruction might be reduced. The first is through development of special-purpose computers and associated equipment designed for specific educational applications. Such computers could be of highly simplified design, since they would need to incorporate only the storage capacity and the operating speed and flexibility necessary for one specific job.

The special-purpose computer offers the advantage of greater efficiency in a particular task. On the other hand, the inflexibility of a special-purpose computer may prevent it from serving as a basis for expanding electronic techniques to other areas of the operations. Since these computers do only a specific job, they contribute to a compartmentalized view of school operations.

A multitude of such practical problems must be solved if computers are to have wide-spread utility in education. If these problems can be solved, and if the full potentials of high-speed data processing can be realized throughout the educational system, we may expect some of the greatest changes seen in education for hundreds of years.

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DESCRIPTORS: Teaching Machines.
Data Processing Systems.

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